REMARKS

Claim 1 is currently amended to include the limitation that the lump feed material is hematite, which supported in specification on page 5, lines 11 - 12. Claim 8 is amended to include the limitation that the lump feed material is hematite, which is supported in specification on page 5, lines 11 – 12, and to include the temperature gradient in the first half meter of the furnace.

Claims 1-5 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Villarreal-Trevino et al., U.S. Patent 6,395,056 in view of Lotosh et al., U.S. Patent 4,049,435 and further in view of Becerra-Novoa et al., U.S. Patent 5,445,3630.

With respect to claims 1 and 2, the Examiner states Villarreal-Trevino et al. discloses that the invention is applied to lumps of iron ore. Examiner further states that Villarreal-Trevino et al. discloses a method that includes a non-reducing (preferably oxidizing) atmosphere. Examiner is now in accord that Villarreal-Trevino et al. does not teach Applicants' temperature range for preheating of 200° C to about 500° C. Examiner asserts that Lotosh et al. teaches heating to temperatures of 200° C and 400° C with resultant strengthening, and that these temperatures overlap Applicants' temperature range. While Villarreal-Trevino et al. doesn't explicitly state that the feed bin is enclosed or that the transporting means is insulated, it is implicit and Becerra-Novoa et al. discloses insulated piping to conserve energy.

Applicants claim 1 claims "hematite lump feed material". As taught in the specification lump feed material is cheaper than a pellet or a briquette, as it does not require the processing of making a pellet or a briquette. Lotosh et al. teaches a pellet of magnetite ($Fe^{+2.25}$) and Portland

cement. Both Applicants (on page 5, line 11) and Villarreal-Trevino et al. (in col. 2, lines 13-19) teach that the process of converting a lump of hematite (Fe^{+3}) to magnetite ($Fe^{+2.25}$) is largely determinative of the degree of decrepitation. Magnetite is already partially reduced from Fe^{+3} to $Fe^{+2.25}$. As Lotosh et al. reads on a pellet of magnetite ($Fe^{+2.25}$) and Portland cement, it is not an applicable reference because Applicants employ neither a pellet, nor magnetite feed material, nor Portland cement. The Examiner also failed to point out that the Lotosh et al. pellets are also steamed, air dried, and then dried again at 200° C and /or 400° C. It is not unexpected that if one adds cement that there would be an increase in pellet strength. Further evidence that Lotosh et al. is not applicable can be gleaned from the patent classification, as Lotosh et al. is in a different class and subclass. As the Examiner noted, Villarreal-Trevino's et al. process of drying starts at *about* 750° C, while Applicants' temperature range for preheating is 200° C to about 500° C. Applicants claim a non-reducing atmosphere, while Villarreal-Trevino et al. reads on an oxidizing gas (col. 2, lines 48-49). The Examiner has equated a non-reducing atmosphere to an oxidizing atmosphere. This is not necessarily the case. For instance, an inert atmosphere is a non-reducing atmosphere, but it is not an oxidizing atmosphere. In col. 2, lines 1-19, Villarreal-Trevino et al. teaches [oxidation] "allows retention time between hemetite to magnetite to be decreased, and allows a smooth change of stereometry between the structures of hematite and magnetite". In other words, at 750° C, without oxygen, the temperature is high enough to convert hematite and magnetite. Applicants' lower preheating temperature prevents the problem of the spontaneous conversion of hematite to magnetite, while still preconditioning the lump ore feed material. Finally, Villarreal-Trevino et al. is largely silent on how long his process takes. Applicants claim a process that sees a steep increase in temperature, on the order of at least a 250° C increase in temperature over 20 minutes in the first half meter of the furnace. <u>Applicants process appears to be faster overall, because the DRI process would</u>

be less hindered by the residual oxidation gases that are present in Villarreal-Trevino's et al. preheated material coming to the furnace from the oxidizing preheating device. In summary, Applicants do not have preheated material saturated with an oxidizing gas; Applicants' process is at least 250° C cooler; Applicants' process is faster overall since there are no residual oxidizing gases in the preheated material that slow the reduction step; and Applicants' process is less expensive since lower preheating temperatures are required. Furthermore, as taught on page 9 lines 3-6 of the specification, the lower operating temperatures negate the need for refractory materials, which are significantly more expensive than steel. As to Becerra-Nova et al, the insulated piping 38 identified by the Examiner is a duct (see col. 8, line 57) for conveying DRI, not preheated iron ore lumps, and the pipe is 200 to 300 meters and up to 2000 meters long. A pipe this long would of course be thermally insulated, especially one that is pneumatic as taught by Becerra-Nova et al., because the pressure would drop as the gases cool along the very long pipe. The insulated charging system claimed by Applicants insulates the preheated material from reducing gases in the furnace, as well as providing thermal insulation. Becerra-Nova et al does not read on a charging system that moves material from a storage bin having an inert or non-reducing atmosphere to furnace having a reducing atmosphere. The claimed insulation is atmospheric as well as thermal, in that the insulation refers to isolating the gases that come into contact with the lump iron during the predrying step from the DRI reducing gases in the furnace, and also isolating the temperature in the predrying bin that the iron ore is exposed to from the temperature attained in the furnace.

With respect to claims 3 and 4, the Examiner states that while Villarreal-Trevino et al. is not explicit as to how to heat a feed storage bin, Villarreal-Trevino et al. do generate a hot-reducing gas

stream by combustion and waste off-gases (col. 4, lines 25-32), and it would be obvious to one of ordinary skill to provide these gases for the feed storage bin.

Applicants agree with the Examiner that Villarreal-Trevino et al. could probably generate inert or non-reducing gases at a certain temperature range, **if** motivated to do so. However, Villarreal-Trevino et al. teaches that preheating is at about 750° C under oxidative conditions, not inert or non-reducing conditions. What is actually taught by Villarreal-Trevino et al. in col. 4, lines 24-25, is "hot combustion gases 14 which provide an oxidizing atmosphere" in the preheating device. The "hot combustion gases 14 which provide an oxidizing atmosphere" are not compositionally nor functionally the same / equivalent to non-reducing gases claimed by the Applicants. Villarreal-Trevino et al gases, as shown in Fig. 1, have additional fuel 18 and air 20 added, while Applicants' preheating gases have cooling air 28 added as shown in Fig. 1. Examiner further states that with respect to claims 3 and 4 Villarreal-Trevino et al. teaches combustion of fuel and waste off gases (col. 4, lines 25-32) to provide a hot non-reducing gas stream. In these lines, Villarreal-Trevino et al. is disclosing how to regenerate the DRI gases, and the DRI gases are reducing (col.4 line 34). This would be unsuitable for the Applicants' preheating storage bin, which are significantly cooler and not reducing. The Examiner in effect is rejecting the claims on the basis of hindsight from Applicants' own disclosure, not the teaching or motivation of Villarreal-Trevino et al.

Applicants' claim 5 derives its novelty through its dependency from claim 1.

Claim 8 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Villarreal-Trevino et al., U.S. Patent 6,395,056 in view of Lotosh et al., U.S. Patent 4,049,435 in view of Becerra-Novoa et al., U.S. Patent 5,445,3630 alone or in view if Weedon et al., (June 2000). The Examiner admits that even though Villarreal-Trevino et al. doesn't teach that the feed material is heated to

about 750° C within the first ½ meter of descent in the furnace, it is the Examiner's position is that this would be the case, since Villarreal-Trevino et al. teaches-preheating to a temperature of above 700°C.

Applicants have currently amended claim 8 to include a starting temperature of less than or equal to 500° C, and a time period of less than 20 minutes. Since Villarreal-Trevino's et al. material is already about 750° C when it leaves the pre-heater, then Villarreal-Trevino's et al. material is not in Applicants' temperature range. The Applicants are teaching that the temperature rises very fast, and that initially the material is moving vertically through the furnace on the order of 1inch/minute. Villarreal-Trevino's et al. is largely silent on any temperature flux, because as the Examiner correctly points out, the incoming preheated material is already on the order of 700°C - 750°C, so there is little if any temperature flux.

Further with regard to claim 8, the Examiner also notes that Weedon et al. teaches that the solid lump feed material doesn't break up as much if it doesn't fall as far. Weedon et al. teaches that a fall of 1 meter or less reduces the fines formation.

Applicants' reference to a ½ meter, in claim 8, is not a drop test, but the speed with which the temperature is increased. The furnace is loaded from the top, and temperature increases as the material descends through the furnace (from ~400° C to ~750° C in ½ meter). See page 8, lines 19-21, of the specification. As far as the teaching of Weedon's et al. being relevant to Applicants' invention, the pertinent fact is not how far a lump moves, but how fast it is moving when it stops. The average velocity of Applicants lump, which is moving ½ meter in 20 minutes, is only about 1 inch/minute or 0.0167 in/sec. Under the force of gravity (the conditions for Weedon's et al), a lump will free fall from a distance of ½ meter in about 0.32 sec ($s = 16t^2$, where ½ meter = 1.64 ft), and at impact will be have a velocity of 122.9 in/sec (versus Applicants 0.0167 in/sec when moving ½

meter in 20 minutes) . This is about 7358 times faster than the lump of iron ore in Applicants' furnace. A height capable of producing a velocity of 0.0167 in/sec is negligible, where the lump's speed is determined by gravity. Again, as far as the quantity of fines and a drop test, it is not how far a lump moves, but how fast it is moving when it stops. Applicants are claiming a temperature flux, and how even with a relatively quick increase in temperature, there can be a reduction in fines. Applicants are not claiming a relationship between drop height and fines. In view of the arguments and the amendment, claim 8 is now believed to be in condition for allowance.

In view of the foregoing amendment and these remarks, this Application is now believed to be in condition for allowance and such favorable action is respectfully requested on behalf of Applicants.

Respectfully submitted,

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FRB/RHD/bcb
Attorney's Docket No. 3566